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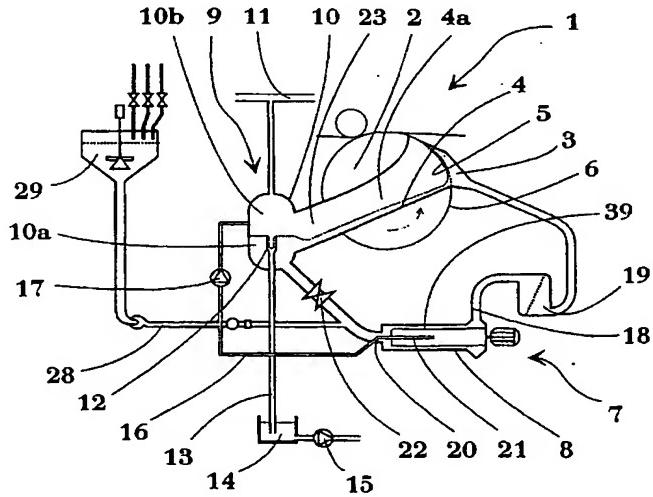
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(54) Title: A PROCESS AND AN APPARATUS FOR FORMING A WEB



(57) **Abstract:** The invention relates to a process in connection with the forming of a material web especially at a head box (3) of a former (1). Liquid from the material web is recirculated to an inlet (20) of a degassing pump (8) having an internal deaerating surface, and the pulp flow to the material web (30) is regulated in such a way that the rotation speed of the degassing pump (8) is used to control the pressure of the pulp at the head box (3) while the pulp flow is regulated by means of valve means (22a) provided at the inlet (20) of the degassing pump (8). The invention also relates to an apparatus at a head box (3) wherein a degassing pump (8) having an internal deaerating surface is provided in a liquid circulation loop for the recirculation of pulp. The degassing pump (8) is arranged to regulate the pressure in the head box (3) with the aid of the rotation speed of the pump (8), while throttling means (22a) are provided at the inlet side (20) of the degassing pump (8) for regulating the amount of pulp being led to the head box (3).

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A PROCESS AND AN APPARATUS FOR FORMING A WEB

The present invention relates to a process in the forming of a material web such as a paper web or the like at the head box of a former or the like apparatus which suitably comprises a forming fabric in accordance with the preamble of the appended independent process claim. The invention also relates to an arrangement in connection with a former or the like in accordance with the preamble of the appended independent apparatus claim.

The paper and pulp industry utilizes various arrangements for introducing a substantially thin or diluted fluid, a so called stock, which contains pulp particles, to a wire in order to form a pulp web on the same. This web is then forwarded to further processing. Such arrangements normally include a so called head box where said stock is brought into contact with and distributed over a fabric through which the liquid may run while the pulp is retained at the fabric in order to be further processed. The liquid is removed in the form of back water possibly for being reused in the process after cleaning.

Especially in the production of multy-ply material, a so called cylinder-vat unit is used which comprises a drum or cylinder which rotates in the diluted liquid. The liquid is made to filter through a felt arranged over the surface of the drum with the aid of a pressure difference between the outer and inner surfaces of the drum. The pulp particles remain on the felt surface while the liquid runs off.

For producing a multy-ply web several forming steps may be provided along the same fabric. Such an arrangement is especially usual in case of said cylinder-vat units. A number of problems are, however, encountered in connection with known cylinder-vat plants. Known cylinder-vat units of an older type normally comprise an open inlet to a liquid vat in which the cylinder rotates. Any liquid which has filtered through the

wire is led in the form of recirculating back water via an essentially open system to a vessel from where it in time is pumped back to the process. In case the forming is performed with the aid of one or more individual head boxes the back water is usually drained by allowing it to drip through the fabric down into open vessels from which the back water is transported onwards. Other systems are a vacuum arrangement where the drained water is actively collected in barometric pipes. This water is thereafter transported to open troughs which also function as lock water containers for maintaining the water column in the pipe. The back water is pumped onwards from said troughs to the various water systems of the machine.

All of the said open systems have drawbacks which make it difficult to maintain the uniform constant conditions at the actual forming which are a prerequisite for achieving a uniform deposition of pulp on the wire and thus a uniform end product. Moreover, totally open systems in connection with cylinder-vat plants have not allowed increasing the speed of the machines above certain limits which has made them uneconomical. For these reasons attempts have also been made to make the liquid circulation shorter and more closed with the consequence that there are problems with the air which is contained in the back water.

In order to solve the problems caused by air in the liquid, special deaerating devices and tanks for the introduction of pulp have been built. This, on the other hand, has caused the whole plant to include several large vessels and the plant has thus become much more space demanding as regards height and area, which causes a loss of a large part of the advantages otherwise gained e.g. with cylinder-vat units. Moreover, the circulation in any large system is hardly ever uniform wherefore impurities tend to accumulate at certain points in the system. The impurities may then suddenly come loose and pass on with the liquid stream to the web. Providing a uniform mixing of pulp into the liquid has also generally been a difficult problem in the prior art.

An object of the present invention is to provide an arrangement wherein uniform conditions can be maintained within the scope of a very small liquid volume and compact construction.

Another object of the present invention is to provide an arrangement wherein pump means are used to actively maintain a desired pressure difference between the inlet and outlet sides of a former.

An additional object is to improve the general cleanliness of the system in order to thus promote the quality and reduce operational disturbances.

The above mentioned problems and objects are achieved with the aid of an arrangement which is characterized by that which is defined in the appended claims. The process according to the invention is especially characterized in that liquid is recirculated from a material web to the inlet of a degassing pump having an internal deaerating surface, and the pulp flow to the material web is regulated in such a way that the rotation speed of the pump is used to control the pressure of the pulp at the head box while the pulp flow is regulated with the aid of valve means provided at the inlet of the degassing pump. Any possible excess pulp is suitably discharged by means of one or several overflows. A degassing pump with an internal deaerating surface is thus used for adjustably controlling the pulp flow to the material web in a previously unknown way.

The apparatus according to the invention is in its turn characterized in that a degassing pump having an internal deaerating surface is provided in a liquid circulation loop for the recirculation of pulp from the forming, said degassing

pump being arranged to regulate the pressure in the head box with the aid of the rotation speed of the pump, while throttling means are provided at the inlet side of the degassing pump for regulating the amount of pulp being recirculated to the head box.

Fresh diluted pulp is suitably led directly to at least a portion of the liquid drained from the former and the liquid is returned to the former via a degassing arrangement which is suitably essentially closed and provided in a circulation loop which, according to certain embodiments, is essentially closed. Thus, the apparatus comprises a liquid circulation loop including degassing elements which are essentially closed from the outside and means are provided for adding pulp into the liquid drained from the former directly in said circulation loop. According to especially preferred embodiments of the invention, the degassing elements comprise degassing pumps having an internal deaerating surface, said pumps for instance being of the kind disclosed in the same inventor's US patent 5,861,052.

The invention will now be described in greater detail in the form of examples with reference to some preferred embodiments and to the appended drawings, wherein

Fig. 1 shows a sketch of the general principle of the arrangement according to the invention in connection to a cylinder-vat unit,

Fig. 2 shows another embodiment of the invention,

Fig. 3 shows an alternative circulation via special cleaning stages, and

Fig. 4 shows a modification of the embodiment according to Fig. 3.

As shown by Fig. 1, the arrangement in connection with a cylinder-vat unit generally includes a former designated 1 and comprising a forming cylinder 2 of a kind known per se. The cylinder driven by driving means known per se (not shown). At the outer surface of the cylinder 2 a head box 3 is provided in a well known way. The head box introduces a liquid with pulp mixed therein to the cylinder surface. The liquid is made to filter through cloth means (not shown) provided on the cylinder so that a substantial portion of the introduced pulp is deposited on the surface of the cloth while liquid in the form of back water 4 passes through the cloth.

According to this preferred embodiment of the invention, the cloth has an inner side 5 facing the cylinder 2 and an outer side 6 provided for the deposition of pulp thereon. In the preferred embodiment the liquid flow from the inner side 5 of the cloth to the outer side 6 of the cloth is arranged to provide an essentially closed circulation loop 7 without any open vessels or other arrangements commonly used in the prior art for balancing variations in the liquid flow or for providing deaeration of large amounts of air. According to this embodiment of the invention, the circulation loop contains instead special essentially closed degassing elements in the circulation 7. Said degassing elements primarily consist of two parts, and fresh diluted pulp is preferably added between said parts for being forwarded to the outer side 6 of the cloth on the cylinder 2.

According to the shown especially preferred embodiment, the degassing elements consist, on one hand, of a degassing pump 8 as mentioned above and, on the other hand, of a special gas separator 9. Said gas separator 9 operates for providing primary degassing of the back water 4 drained at the inner surface of the cylinder 2. After addition of pulp thereto, said back water is returned via the circulation loop 7 to the cloth on the outer side of the cylinder 2. Said back water 4 contains a certain amount of gas, generally air, especially since the cylinder 2 and the cloth bring air to the boundary

layer between the pressure side 6 and the vacuum side 5 of the circulation loop 7. The term pressure side 6 is herein intended to mean the side of the forming cylinder 2 on which the forming cloth is applied and on top of which pulp is deposited at the head box 3 during the forming. The term vacuum side 5 correspondingly means the opposite side of the forming cloth, which usually but not necessarily also is the inner side of the cylinder 2.

In the embodiment shown in Figs 1, the gas separator 9 comprises a vessel 10 with an upper gas outlet 11, which suitably has a slight under-pressure or vacuum in comparison to the pressure of the surrounding atmosphere and/or in comparison to the pressure at the other components of the circulation loop, in order to remove any gas that is freed in the vessel 10. The vessel 10 is preferably also provided with a liquid overflow 12 for any excess liquid introduced into the system in connection with the addition of pulp which is described in greater detail below. Said overflow 12 is suitably via a pipe 13 connected to a collecting trough 14 for excess liquid, which is pumped off with a pump 15. Taking into account the vacuum which is desired in the vessel 10, the pipe 13 preferably comprises a suitable difference in level between said liquid overflow 12 and the surface in the trough 14. This surface may be a free surface since the liquid which is led to the trough 14 no longer takes part in the circulation around the former.

The above described deaeration arrangement is capable of freeing most of the gas contained in the back water 4 coming from the forming cylinder 2. Any liquid which accumulates in the lower part 10a of the vessel 10 is led back towards the inlet 20 of the pump 8 via a channel 25. Any rests of gas which possibly remain in the back water are now removed from the circulation at the deaerating surface 39 of said degassing pump 8. A vacuum in relation to the rest of the system is preferably maintained in the pump 8 by suitably connecting an outlet gas channel 16 of the pump 8 via a compressor 17 to

said degassing vessel 10, preferably to the vessel part 10b which mainly comprises gas phases, while the outlet 18 on the pressure side of the pump 8 is arranged to feed liquid enriched with pulp to the outer surface 6 of the forming cylinder 2. In the flow direction behind said outlet 18 there is suitably provided a screen device 19, which is known per se. The desired difference in pressure between the outer side 6 and the inner side 5 of the forming cylinder 2 is suitably maintained with the aid of said degassing pump 8. The pump 8 thus also forms an essential part of the degassing arrangement in the closed liquid circulation loop.

The pulp which is to be deposited and formed on the cloth which is provided on the forming cylinder 2 is suitably added in the form of diluted pulp which is led to the inlet 20 of the degassing pump 8. At the outlet 18 of the pump this pulp is forwarded to the outer side 6 of the forming cylinder 2 where the web is formed. The actual forming is suitably effected by maintaining a slight pressure difference over the cloth between its two sides 6 and 5. According to the invention, this is provided by controlling the operating parameters of the degassing pump 8, i.e. the pump's outlet pressure, which depends on its speed of rotation, and the pulp flow, which is controlled by valve means as is described in greater detail below. In practice, the operation is preferably effected by using the vacuum at the inlet 20 of the degassing pump 8 also for draining off liquid inside the forming cylinder 2, while the vacuum in the pipe 11 is used for removing the gases which are separated from the liquid. This liquid, i.e. the back water 4 is then led via the gas separator 9, which in the embodiment shown in Fig. 1 comprises the closed degassing chamber 10, into the circulation loop, to be returned to the degassing pump 8.

In accordance with the invention, the arrangement is such that the liquid flow and/or the pressure in the former 1 is controlled by the variable pumping speed of the degassing pump 8. In this way it is possible to utilize a constant or controlled speed of the pump means 8, for maintaining a desired pressure difference in the various parts of the closed system, especially on either side of the forming cloth. The speed control of the pump means is preferably based on the other operational parameters of the system. The compressor 17 is here suitably used for maintaining a lower pressure in the degassing pump 8 and especially at its degassing central portion 21 than in the gas separator 9. To this end the compressor 17 preferably comprises a means (not shown) for driving the compressor at a constant or suitably at a variable speed so that the control of this pressure difference can be used for controlling the balance of the system. The gas separator is generally held at a certain under-pressure or vacuum but also such embodiments are envisaged wherein the pressure in the gas separator substantially corresponds to that of the ambient atmosphere.

The embodiment shown in Fig. 1 generally discloses that the draining off from the back side 5 of the forming cylinder 2 is effected via a relatively wide channel 23. The back water 4 flows downwards along the bottom of the channel. An essentially free space 4a is formed above the liquid surface in the channel 23 and a certain deaeration takes place therein immediately after the draining and continues all the way to the gas separator 9.

In the alternative shown in Fig. 2, the back side of the forming cylinder 2 is construed as separate and distinctly defined sections 23a, 23b and 23c. The sections are preferably provided with their individual channels 24a, 24b and 24c, respectively, which connect them to a collecting channel 25 which is directly joined to the inlet 20 of the degassing pump 8. The channels 24a...24c form in cooperation with a vessel 26 a water seal in a way known per se. The water seal is in

balance with the vacuum which is maintained in the respective sections 23a...23c. Said vessel 26 has a function corresponding to that of the vessel 14 in the embodiment according to Fig. 1 and is connected via a special pipe 27 to a common collecting channel 25 for the individual channels 24a...24c.

The actual addition 28 of pulp to the system is suitably provided in the flow direction behind the gas separator 9 or the connection 27 to the vessel 26 and ahead of the degassing pump 8. Said addition of pulp comprises well known elements 29 which are not described in detail herein. By controlling, on one hand, the speed and, on the other hand, the pumping capacity of the degassing pump 8 in accordance with the invention it is possible to control the flow and pressure in the head box 3 of the former 1 and thus to control the deposition on the cloth.

The embodiment according to Fig. 3 comprises a prior art head box 3 provided directly at a forming wire 30. The pulp is deposited on said wire while the back water 4 is allowed to drip down into an open trough or save-all tray 36 under the wire 30. Water which is sucked out through the suction boxes 23d, and suitably water from a first overflow 37, is led directly to further processing in a cleaning stage 31, while a second overflow 35 discharges any excess water. The main part of water which reaches the trough 36 is led via an inlet valve 22a, which in the shown embodiment is provided in the degassing pump 8 at the inlet thereof. In another embodiment of the invention, the valve 22 is separately provided in the inlet pipe to the pump 8.

In this embodiment the degassing pump 8, as such, takes care of the whole degassing function. In the arrangement according to this embodiment the pulp addition 28 is also arranged at the inlet 20 of the pump 8, while the outlet 18 in this case is connected to special cleaning stages 31, the function of which is, as such, the object of a parallel patent

application. From this cleaning stage the back water enriched with pulp is suitably led via a screening device 19 back to the head box. This embodiment preferably includes valve means 32, 33 for controlling the degassing process. Said valve means can be used for controlling the relationship between the amount of liquid which is led to the head box 3 and the amount of liquid which after the cleaning stage 31 is returned 34 and is possibly led back to the pump 8 for further degassing. This arrangement also provides a short essentially closed liquid recirculation wherein any excess liquid corresponding to the amount added with the diluted pulp, is discharged from the circulation loop via an overflow 35.

The embodiment according to Fig. 4 is generally a variant of the embodiment according to Fig. 3. Herein the addition of pulp is arranged to flow directly to a cleaning stage 31, wherefrom the pulp is led e.g. to a head box 3, suitably via a screening device 19. Water dripping down on the save-all tray 36 or being sucked out via the suction boxes 23d is, however, not led directly to the cleaning stages 31 but is instead led to the inlet 20 of the pump 8 via a pipe 38. A first overflow 37 from the save-all tray 36 is also connected to said pipe, while a second overflow 35 leads away to discharge.

In the description above some preferred embodiments of the invention have been described only as examples. It will, however, be evident for the person skilled in the art that the invention can be applied in many other ways within the scope defined in the appended claims.

Claims

1. A process in connection with the forming of a material web such as a paper web or the like at a head box (3) of a former (1) or the like apparatus, characterized in that liquid is recirculated from the material web to an inlet (20) of a degassing pump (8) having an internal deaerating surface (39), and the pulp flow to the material web (30) is regulated in such a way that the rotation speed of the degassing pump (8) is used to control the pressure of the pulp at the head box (3) while the pulp flow is regulated by means of valve means (22, 22a) provided at the inlet (20) of the degassing pump (8).
2. Process according to claim 1, characterized in that the regulation is performed by throttling the pulp flow from the recirculation to the degassing pump (8), while any excess pulp from the recirculation is discharged via overflows (12, 35, 37) and diluted pulp is suitably added according to need to the inlet of the degassing pump (8).
3. Process according to claim 1 or 2, characterized in that the flow and/or the pressure in the former (1) is controlled with the aid of a variable pumping speed of the degassing pump (8).
4. Process according to any one of claims 1 to 3, characterized in that a desired pressure difference is maintained in the different parts of the closed system, especially on each side of the surface (6) of the former (1), with the aid of pump means having a constant or variable speed.
5. An apparatus in connection with a head box (3) of a former (1) for forming a material web such as a paper web (30) or the like, characterized in that a degassing pump (8) having an internal deaerating surface is provided in a liquid circulation loop (7) for the recirculation of pulp, said degassing pump (8) being arranged to regulate the pressure in

the head box (3) with the aid of the rotation speed of the pump (8), while throttling means (22, 22a) are provided at the inlet side (20) of the degassing pump (8) for regulating the amount of pulp being led to the head box (3).

6. Apparatus according to claim 5 characterized in that means (28, 29) are provided for adding pulp to the liquid recirculated from the former (1) directly in said circulation loop, suitably so that the inlet for pulp is arranged in the flow direction behind a gas separator (9, 10, 26) and ahead of said degassing pump (8), overflows (12, 35, 37) suitably being provided in the circulation loop for the removal of excess pulp.

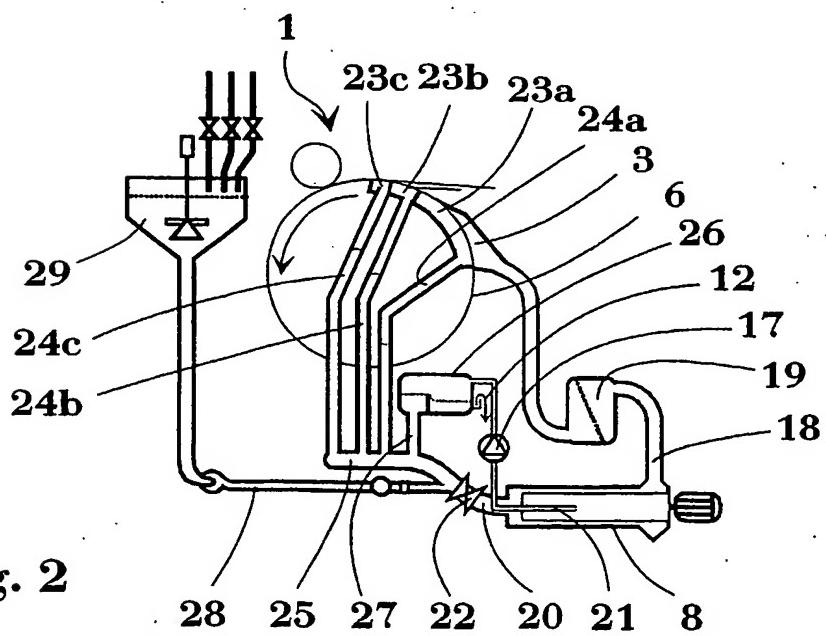
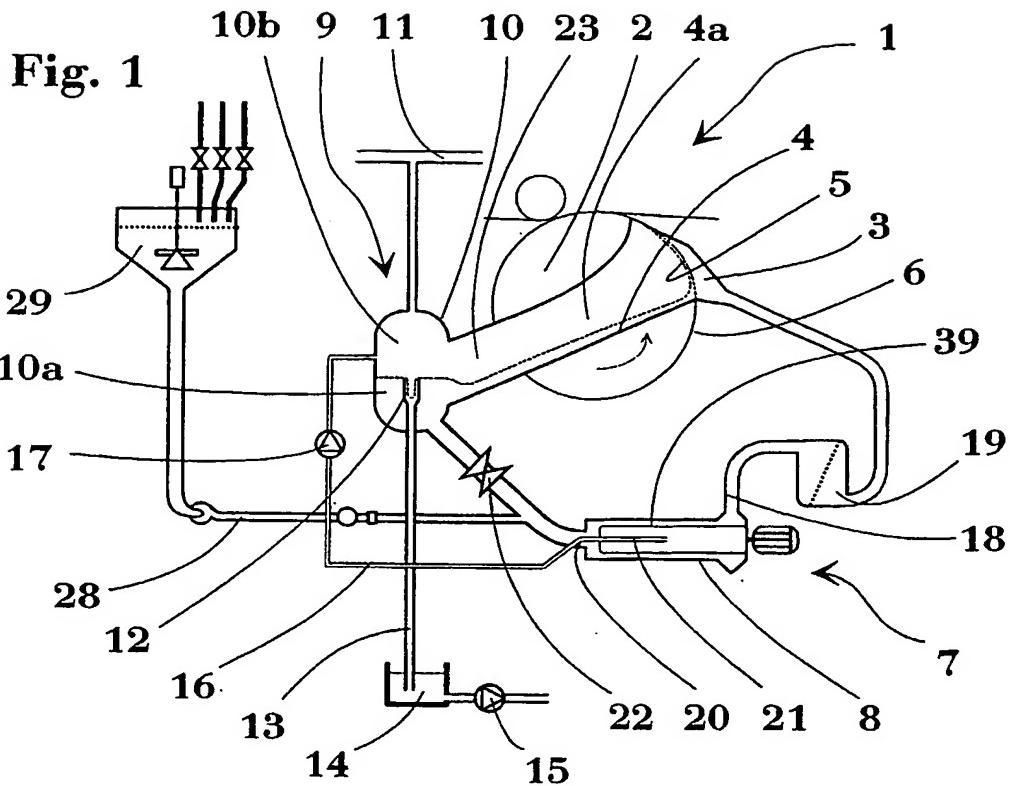
7. Apparatus according to claim 5 or 6 characterized in that means (11) are provided for maintaining a pressure lower than that of the ambient atmosphere in said gas separator (9, 10, 26).

8. Apparatus according to any one of claims 5 to 7, characterized in that means (17) are provided for maintaining, in said degassing pump (8), a pressure lower than that of said gas separator (9, 10, 26).

9. Apparatus according to any one of claims 5 to 8, characterized in that the gas separator (9, 10, 26) is provided as a closed vessel either as a channel (23) which is common for several forming stages and/or as one or more vessels (23a, 23b, 23c, 23d) specific for each stage.

10. Apparatus according to any one of claims 5 to 9, characterized in that an arrangement (19) for the screening of the pulp is provided in the flow direction behind the pressure side (18) of the degassing pump (8) and ahead of the outer surface (6) of the former (3), and/or that the outlet (18) of the degassing pump (8) is connected to one or more cleaning stages (31), which in their turn are connected to said head box (3).

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**Fig. 2**

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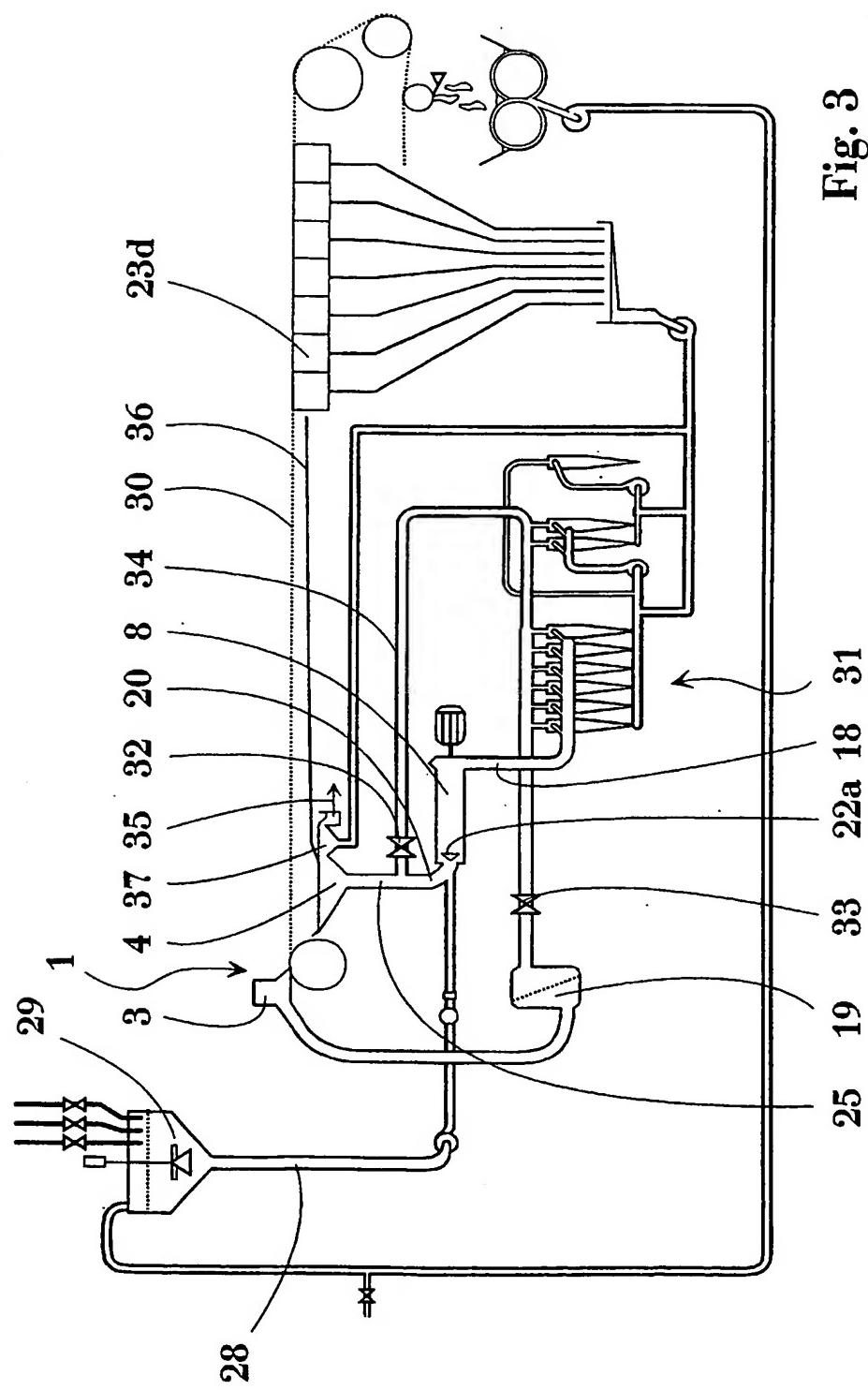


Fig. 3

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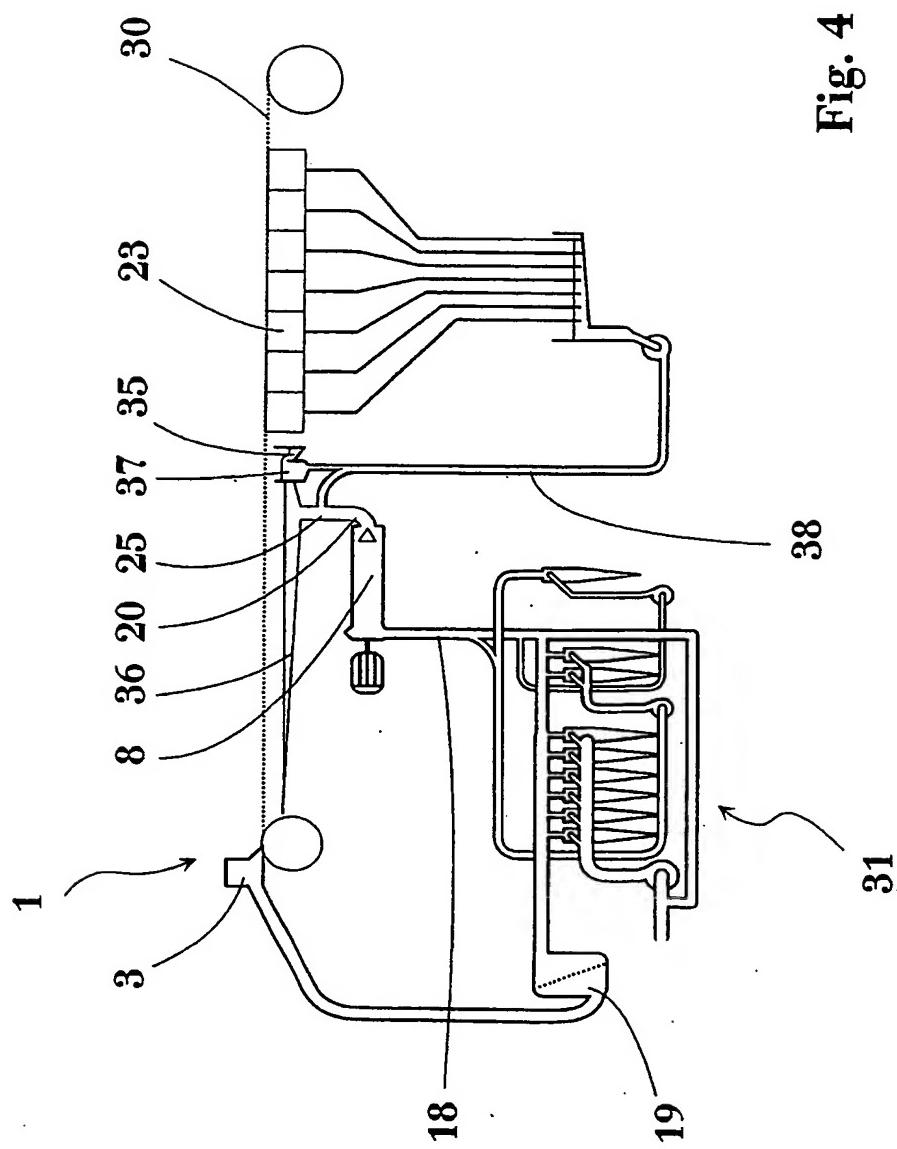


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00364

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 1/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALINDEX: ALLSCIENCE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9964668 A1 (VALMET CORPORATION), 16 December 1999 (16.12.99) --	1,5
A	US 5861052 A (PAUL OLOF MEINANDER), 19 January 1999 (19.01.99) -- -----	1,5

Further documents are listed in the continuation of Box C.

See patent family annex.

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- "P" document published prior to the international filing date but later than the priority date claimed

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- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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18 July 2001

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INTERNATIONAL SEARCH REPORT
Information on patent family members

02/07/01

International application No. PCT/FI 01/00364	
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9964668 A1	16/12/99	AU 4619999 A BR 9911529 A DE 29909960 U EP 1102887 A FI 103676 B FI 981327 D	30/12/99 20/03/01 09/09/99 30/05/01 00/00/00 00/00/00
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